PCT WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau

INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 :
H01R 23/26, 35/00

A1

(11) International Publication Number: WO 97/02630

(43) International Publication Date: 23 January 1997 (23.01.97)

(21) International Application Number: PCT/SE96/00885

(22) International Filing Date: 2 July 1996 (02.07.96)

(30) Priority Data:
9502404-8 3 July 1995 (03.07.95) SE

(71) Applicant *(for all designated States except US)*: LUNDGREN & NORDSTRAND AB [SE/SE]; Monbijougatan 17 B, S-211 53 Malmö (SE).

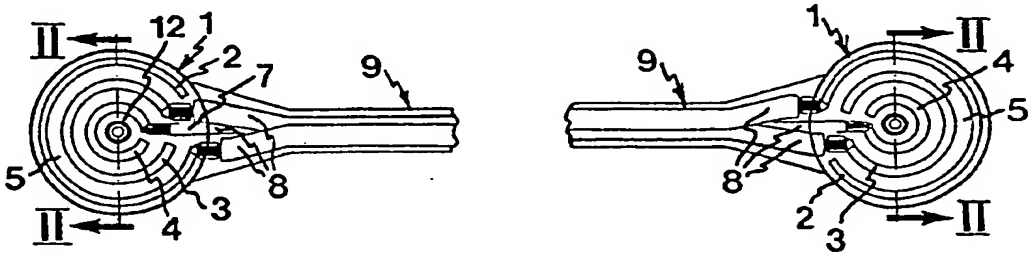
(72) Inventors; and
(75) Inventors/Applicants *(for US only)*: LUNDGREN, Sten [SE/SE]; Latinlinjen 2, S-224 73 Lund (SE). TANIMURA, Richard [SE/SE]; Envigsgränden 14, S-224 75 Lund (SE).

(74) Agent: AWAPATENT AB; P.O. Box 5117, S-200 71 Malmö (SE).

(81) Designated States: JP, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE).

Published
With international search report.
In English translation (filed in Swedish).

(54) Title: COUPLING DEVICE



(57) Abstract

A coupling device comprises a cable (9) having at least two conductors (8) and a coupling means (1) at each end of the cable, the coupling means each having contact elements (2-4) which are each connected to one conductor. Each coupling means (1) consists of a circular disc (1'; 1'') of an electrically insulating material, the electric contact elements (2-4) being each extended along a circle which is concentric with the disc centre and which is positioned on one major face (5) of the disc.

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AM	Armenia	GB	United Kingdom	MW	Malawi
AT	Austria	GE	Georgia	MX	Mexico
AU	Australia	GN	Guinea	NE	Niger
BB	Barbados	GR	Greece	NL	Netherlands
BE	Belgium	HU	Hungary	NO	Norway
BF	Burkina Faso	IE	Ireland	NZ	New Zealand
BG	Bulgaria	IT	Italy	PL	Poland
BJ	Benin	JP	Japan	PT	Portugal
BR	Brazil	KE	Kenya	RO	Romania
BY	Belarus	KG	Kyrgystan	RU	Russian Federation
CA	Canada	KP	Democratic People's Republic of Korea	SD	Sudan
CF	Central African Republic			SE	Sweden
CG	Congo	KR	Republic of Korea	SG	Singapore
CH	Switzerland	KZ	Kazakhstan	SI	Slovenia
CI	Côte d'Ivoire	LI	Liechtenstein	SK	Slovakia
CM	Cameroon	LK	Sri Lanka	SN	Senegal
CN	China	LR	Liberia	SZ	Swaziland
CS	Czechoslovakia	LT	Lithuania	TD	Chad
CZ	Czech Republic	LU	Luxembourg	TG	Togo
DE	Germany	LV	Larvia	TJ	Tajikistan
DK	Denmark	MC	Monaco	TT	Trinidad and Tobago
EE	Estonia	MD	Republic of Moldova	UA	Ukraine
ES	Spain	MG	Madagascar	UG	Uganda
FI	Finland	ML	Mali	US	United States of America
FR	France	MN	Mongolia	UZ	Uzbekistan
GA	Gabon	MR	Mauritania	VN	Viet Nam

COUPLING DEVICE

The present invention generally relates to a coupling device for electric systems, especially for systems with a plurality of units on one hand requiring power supply and on the other hand being able to communicate with each other.

The units in such electric systems are coupled to each other by means of electric conductors and the coupling is usually performed in coupling boxes, this being a time-consuming procedure.

Certainly, coupling devices mainly for power supply are already known, comprising a cable with at least two conductors and a coupling means at each end of the cable, each coupling means having contact elements each connected to one conductor. Usually, one of the coupling means of these known coupling devices is a male one and the other a female one, by this restricting their adaptability. Furthermore, simpler electric coupling means normally cannot be used as they do not satisfy the existing security requirements regarding e.g. tightness.

Therefore, a first object of the present invention is to provide a simple coupling device of the type mentioned above, eliminating coupling boxes by enabling a fast coupling of several cables to each other and/or to different devices or circuits. It must also be possible to connect the cables in different relative directions.

A second object of the invention is to achieve such a coupling device which also satisfies the existing requirements for tightness, i.e. which enables a close relative coupling of components included in electric equipment.

A rotatable coupling of a cable to the pins of a plug is already known from US-A-4,026,618. Here, a circular disc is used, which is made of an electrically insulating material with two electric contact elements each extending along a circle which is concentric with

the disc centre and which is positioned on one major face of the disc, and each being provided with a connection conductor projecting radially from the disc. The plug has one more such a circular disc with the two plug pins connected to the two electric contact elements in place of the two radially projecting connection conductors. As a consequence of this design, the connection conductors might be arranged in arbitrary rotatable positions in relation to the two plug pins.

The present invention uses part of the design of the plug known in the art to provide a coupling between the various cables in various relative directions.

Thus, a coupling device according to the present invention comprises a cable having at least two conductors, as well as at least two coupling means, each having contact elements which are each connected to one conductor at or between the cable ends, and according to the invention this coupling device is characterised in that each coupling means consists of a circular disc of an electrically insulating material, the electric contact elements each extending along a circle which is concentric with the disc centre and which is positioned on one major face of the disc, that the contact elements on at least one of the circular discs are each axially connected to a contact element on the other disc major face, the latter contact elements each being extended along a circle which is concentric with the disc centre, and that the cable conductors extend essentially radially to the contact elements of each disc with contact elements situated on both major faces.

By this design several devices, circuits and/or cables can be quickly and easily relatively coupled. Thus, the first object of the present invention is achieved.

According to the invention the second object is achieved in that each of the discs on each major face

with contact elements is provided with a sealing element along its whole circumference.

For the uniting of at least two circular discs, means are conveniently arranged for coupling of the circular disc to the other circular disc/discs, each having corresponding electric contact elements and sealing elements along their whole circumference, the sealing elements being axially complementary to the sealing elements of the neighbouring disc with which they are intended to cooperate.

The other circular disc may be identical with the first one, but may also be part of an electric circuit or device, its electric contact elements being necessary on only one of its major faces.

According to the invention it is even possible to build in electrical components or circuits into the circular disc, by its electric contact elements on one major face being coupled to corresponding electric contact elements on the other major face by means of the electric component or circuit which is included in the disc itself.

Thus, the invention provides a uniform coupling system, especially for systems with a serial bus. The coupling device is normally provided with three or four poles, thus implying that one and the same contact with several poles can serve all normal serial bus protocols, including power supply and earthing. The same uniform contact may also be screened.

Thus, the invention provides essential advantages as to simplicity, economy and security. This is achieved among other things by the facts that the power supply as well as the signal communication can be provided simultaneously, that installation and especially cabling operations are simplified and thus installation time is saved, that any pole confusion is eliminated, that wires can be connected relative to each other in almost any direction, that tight couplings are achieved, and that

space can be saved due to the compactness of the coupling.

Various embodiments of the present invention will be described in more detail below with reference to the attached drawings.

Fig. 1 is a plan view of an embodiment of a coupling device according to the invention,

Fig. 2 are cross-sectional views along the lines II-II in Fig. 1,

Fig. 3 is a cross-sectional view of a coupling device according to the invention, the device being based on the coupling device of Fig. 1,

Fig. 4 is a block diagram and shows an electric system using the coupling device according to the invention,

Fig. 5 is a plan view and shows an alternative embodiment of a coupling device according to the invention,

Fig. 6 is a cross-sectional view corresponding to the cross-sectional view in Fig. 3 and shows a first embodiment of the coupling device according to the invention with a light guide,

Fig. 7 is a cross-sectional view corresponding to the cross-sectional view in Fig. 3 and shows a second embodiment of the coupling device according to the invention with a light guide, and

Fig. 8 is a plan view and shows an example with two coupling devices according to the invention, each having a plurality of circular discs.

The coupling device according to the present invention shown in Figs 1 and 2 comprises two coupling means in the form of circular discs 1 of an electrically insulating material and three electrically conductive contact elements 2-4 each extended along a circle which is concentric with the centre of the disc 1 and which is positioned on one major face 5 of the associated disc 1.

According to a variant, the contact elements 2-4 can project into, but not through the disc 1', as shown to the left in Fig. 2. According to another variant, the

contact elements 2-4 can also extend axially through the disc 1", as shown to the right in Fig. 2, thus providing the contact elements 2'-4', each extended along a circle which is concentric with the centre of the disc 1" and which is positioned on the other major face 6 of the disc 1". Thus, the contact elements 2-4 in the latter case form three concentric contact paths on the major face 5, which in cross-section have a convex profile, and also form three concentric contact paths on the major face 6, which have a plane profile, as also shown in Fig. 2. The contact elements 2-4 on the major face 5 may themselves be resilient in the axial direction. Such a resilience can also be achieved by selecting for the disc 1 an electrically insulating material which is somewhat elastic.

According to Fig. 1, the electric contact elements 2-4 do not quite extend through 360° and instead leave a sector 7 of about 45° free in the disc 1. This free sector 7 is used for three conductors 8 in a cable 9 between the two circular discs 1 of the coupling device. The conductors 8 extend essentially radially from one end of the respective contact elements 2-4 and within the associated major face 5, 6.

In the embodiment shown to the left in Fig. 2, the conductors 8 of the cable 9 may alternatively extend axially to the contact elements 2-4, which may then also extend completely through 360°.

Each disc 1 further comprises a centre hole 11 formed in a hub 12 centrally fixed in the disc 1.

The disc 1' also comprises around its outer circumference a flange 13 directed axially from the major face 5. Besides the flange 13 the disc 1" comprises a corresponding circumferential groove 14 in the major face 6. The flange 13 and the groove 14 constitute complementarily formed sealing elements.

In Fig. 2 the disc 1 is shown as a plane disc with a substantially constant thickness. However, the thickness of the disc may decrease somewhat towards the centre

of the disc 1 for reasons that will be explained below. The disc 1 may also have a cross-section other than the plane one shown in Fig. 2, but the major faces 5 and 6 should have an essentially matching shape.

Also the hub 12 of the disc 1" comprises complementarily shaped sealing elements arranged directly around the centre hole 11 in the form of flanges 15, 16 and axially complementary grooves 17, 18. The disc 1' comprises, however, only the flange 15 and the groove 17.

Even if only two discs 1 are shown in Fig. 1, the coupling device according to the invention may comprise further circular discs 1' or 1" between the discs 1 at the ends of the cable 9. An example of two inventive coupling devices interconnected on one spot is shown in Fig. 8.

The coupling device according to the invention shown in Figs 1 and 2 is conveniently produced by injection moulding in a suitable mould, where the contact elements 2-4 coupled to the corresponding conductor 8 and the centre hub 12 are arranged before insertion of the injection-mouldable, electrically insulating material.

Several coupling devices according to the invention may be easily coupled together, as shown in e.g. Fig. 3. Here, three such circular discs 1" as shown in Fig. 2 are placed adjacent to each other with a common axis. For the sake of simplicity, the conductors 8 themselves are not shown in Fig. 3.

As shown in Fig. 3, the contact elements 2-4 of each disc 1" electrically contact the contact elements 2'-4' of each neighbouring disc 1". Conveniently, the contact elements 2-4 and 2'-4' are continuous on each major face 5, 6 outside of the sector 7, but this is not necessary for the electric contact between the contact elements of neighbouring discs.

Each disc 1" seals against the neighbouring disc 1" by means of the sealing elements 13-18 of the discs. To seal the free major faces of the outer discs 1", discs of

an electrically insulating material are used, either with the sealing elements 13, 15 and 17 or the sealing elements 14, 16 and 18. These discs do not necessarily have any electric contact elements. Fig. 3 shows such a disc 19 comprising the sealing elements 14, 16 and 18 and also a centre hub 20 with a radial flange 21 possibly extending over the whole free major face of the disc 19, as shown in the left half of the figure. The shown disc 19 has three circular contact paths 22-24 in positions corresponding to the contact elements 2-4 and 2'-4' on its major face directed towards the free major face of one of the outer discs 1".

Moreover, the disc 19 is provided with a light-emitting diode 25 connected between the contact paths 22 and 23, and a light-emitting diode 26 connected between the contact paths 22 and 24. The light-emitting diodes 25, 26 may thus be used to indicate that an electric voltage is applied over the respective contact elements and, thus, over the corresponding conductors.

As an alternative to the disc 19, a disc 1' could also be used as an upper end of the pile of discs in Fig. 3.

A disc essentially corresponding to the disc 19 can be provided to close the other disc 1" (the lowest one in Fig. 3) with a free major face. All discs can be clamped together by means of a screw joint, a riveted joint or some kind of bundle joint. The centre hubs 12, 20 can also be formed with a bayonet joint to clamp the various discs. The sealing elements 13-18 and the hubs 12, 20 may then have such dimensions in the axial direction that a convenient contact pressure prevails between the contact elements 2-4 and 2'-4' of the various discs when all neighbouring discs are maximally clamped. To achieve the right contact pressure, it may also be convenient to have the thickness of the discs 1 decrease towards the centre.

As shown in Fig. 3, a circular disc 27 essentially conforming with the disc 1' and made of an electrically

insulating material and having contact paths 28-30, whose shape corresponds to the contact paths of, for instance, the contact elements 2-4 on the major face 5 in Fig. 2, can be fixedly mounted in a housing 31 of an electric device. The housing 31 may contain the electric system, which by means of conductors 32-34 is connected to the contact paths 28-30 and thus to the conductors 8 connected to the contact elements 2-4 and 2'-4' of the discs 1. The disc 27 in Fig. 3 has a centre hub 35 with an inner thread to receive a screw 36 which is insertable through the holes in the centre hubs 12 and 20 to clamp the discs 1, 19 and 27 together, the disc 27 and the hub 35 being provided with sealing elements corresponding to the sealing elements 13, 15 and 17 on the disc 1.

Fig. 4 shows an electric system with on one hand a central control unit 37 and, on the other hand, two different types of circuits Q and R. Both the unit 37 and the circuits Q and R have contact discs corresponding to the disc 27 in Fig. 3. The circuits R are also provided with a disc which is complementary to the disc 27 with respect to the sealing elements. By means of a number of coupling devices according to the invention, the system shown in Fig. 4 can thus be easily assembled without using any conventional coupling box. Nevertheless, the couplings thus achieved can comply with the existing requirements regarding tightness and insulation, especially by means of the sealing elements 13-18.

The coupling device described above can be modified in several respects within the scope of the invention. The number of contact elements, however, should at least be two. Fig. 5 shows an embodiment with four contact elements, of which two contact elements 38 and 39 at different distances from the centre of the corresponding disc do not have any connection conductors connected to them. This coupling device is especially suited to connect a number of circuits in a loop, as shown in e.g. Fig. 4,

each circuit in the loop being able to achieve a contact between the contact elements 38 and 39.

As a further modification, electric components or circuits can be accommodated in the interior of the disc 1 and be connected between selected electric contact elements on one and/or the other of the major faces. An example of such a component is a matching resistor.

As illustrated in the left half of Fig. 3, the circumferential surface of the disc 1 may have an electrically conductive coating to provide an electric screen 40 for the inside of the disc 1. This screen 40 can continue around the conductors 8 outside of the disc 1.

By having two of the conductors 8 of a coupling device according to the invention and two corresponding contact elements act as current conductors, also active components and circuits, such as an amplifier, can be incorporated in the disc 1. According to the invention, use is thus advantageously made of two of the contact elements 2-4 or 2'-4', conveniently the outer ones on the disc, as current conductors, while the third one, or further contact elements are used for e.g. signal transmission.

As illustrated in Fig. 6, the coupling device according to the invention can also be used to transmit optical signals, in which case, in addition to the two contact elements 2, 3 and 2', 3', respectively, for power supply, an optical conductor 41 is inserted through the sector 7 into the centre of a disc 1, where it is connected to an optical conductor item 42 which is extended axially in the disc centre and, when connected to another disc 1 of this type, is optically connected to the optical conductor item 42 of that disc.

As shown in Fig. 7, one or more incoming optical conductors 43 can, as an alternative, be connected to an opto-electric converter 44 inserted in the disc 1 and adapted to transmit the optical signal in electric form by means of one of the contact elements 2-4 and 2'-4', respectively.

CLAIMS

1. A coupling device comprising a cable (9) having at least two conductors (8), and at least two coupling means (1, 2-4) each having contact elements (2-4), which are each connected to one conductor at or between the cable ends, c h a r a c t e r i s e d in that each of the coupling means (1, 2-4) consists of a circular disc (1'; 1") of an electrically insulating material, the electric contact elements (2-4) being each extended along a circle which is concentric with the disc centre and which is positioned on one major face (5) of the disc, that the contact elements (2-4) on at least one of the circular discs (1") are each axially connected to a contact element (2'-4') on the other major face (6) of the disc (1"), the latter contact elements (2'-4') extending along a circle which is concentric with the disc centre, and that the conductors (8) of the cable (9) extend essentially radially to the contact elements (2-4; 2'-4') of each disc (1") with contact elements on both of its major faces (5, 6).

2. A coupling device according to claim 1, c h a r a c t e r i s e d in that in each disc (1") with contact elements (2-4; 2'-4') on each major face (5, 6), these contact elements extend axially through the disc to each other.

3. A coupling device according to claim 1 or 2, c h a r a c t e r i s e d in that each of the discs (1) on each major face with contact elements is provided with a sealing element (13; 14) along its whole circumference.

4. A coupling device according to claim 3, c h a r a c t e r i s e d in that each sealing element (e.g. 13) is complementarily designed in the axial direction to a cooperating sealing element (e.g. 14) along the whole circumference of the major face of a separate circular disc (e.g. 27).

5. A coupling device according to claim 4, characterised in that the separate circular disc (27) is provided with corresponding contact elements (28-30) on its major face with the sealing element.

6. A coupling device according to claim 4 or 5, characterised in that the separate circular disc (27) is part of an electric circuit or device (31).

7. A coupling device according to any one of claims 4-6, characterised by means for clamping together (35, 36) the separate disc (27) and one of the circular discs (1) connected to the cable (9).

8. A coupling device according to claim 1, characterised in that an electric component (25, 26) or circuit is accommodated in at least one circular disc (1), the component or circuit being connected between selected electric contact elements on one and/or the other of the disc major faces.

9. A coupling device according to claim 1, characterised in that at least one of the circular discs (1, Fig. 5) has a contact element (38, 39), to which none of the conductors (8) is connected.

10. A coupling device according to any one of the preceding claims, characterised in that each disc (1) has a centre hole (11) with axially complementary sealing elements (15-18) provided around this hole on the major faces (5, 6).

11. A coupling device according to any one of the preceding claims, characterised in that each disc is provided with an electrically conducting screen (40) over its whole circumferential surface.

12. A coupling device according to claim 7, characterised in that the clamping means consist of a screw joint (35, 36), a bayonet joint, a riveted joint or a bundle joint.

13. A coupling device according to claim 1 or 2, characterised in that the conductors (8) of the cable (9) extend essentially radially to the contact

elements (2-4) through a sector (7) of the circular disc (1), the sector being free from the electric contact elements.

14. A coupling device according to claim 13, c h a r a c t e r i s e d in that the electric contact elements (2-4) are continuous on the respective major faces outside of said sector (7).

15. A coupling device according to any one of the preceding claims, c h a r a c t e r i s e d in that at least one of the conductors of the cable is an optical conductor (41; 43), and that this is connected to an electric or optical contact element (2-4; 42) of the disc.

16. A coupling device according to claim 1 or 2, c h a r a c t e r i s e d in that the contact elements (2-4) are resilient in the axial direction on one major face (5) of the disc (1).

1/3

FIG 1

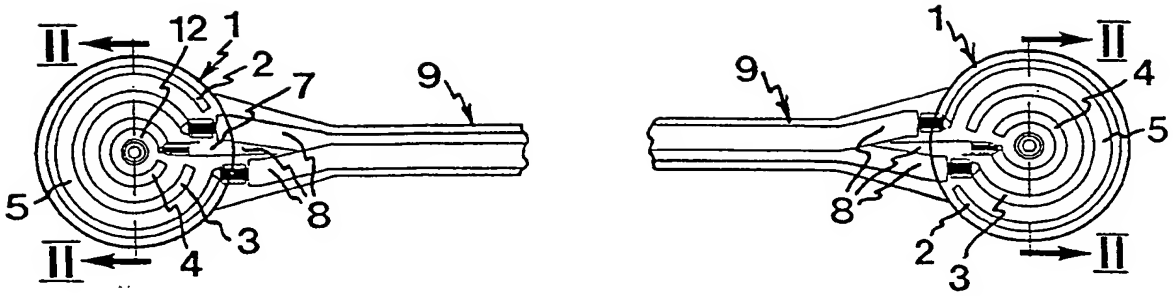


FIG 2

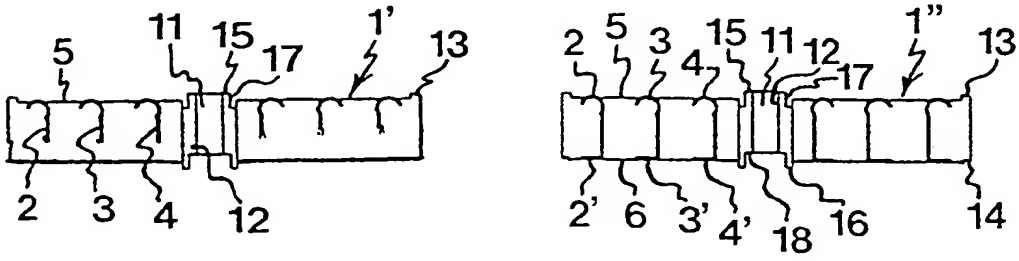


FIG 8

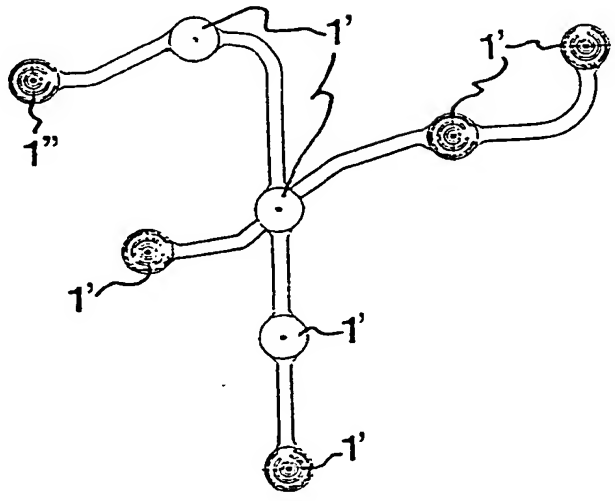


FIG 3

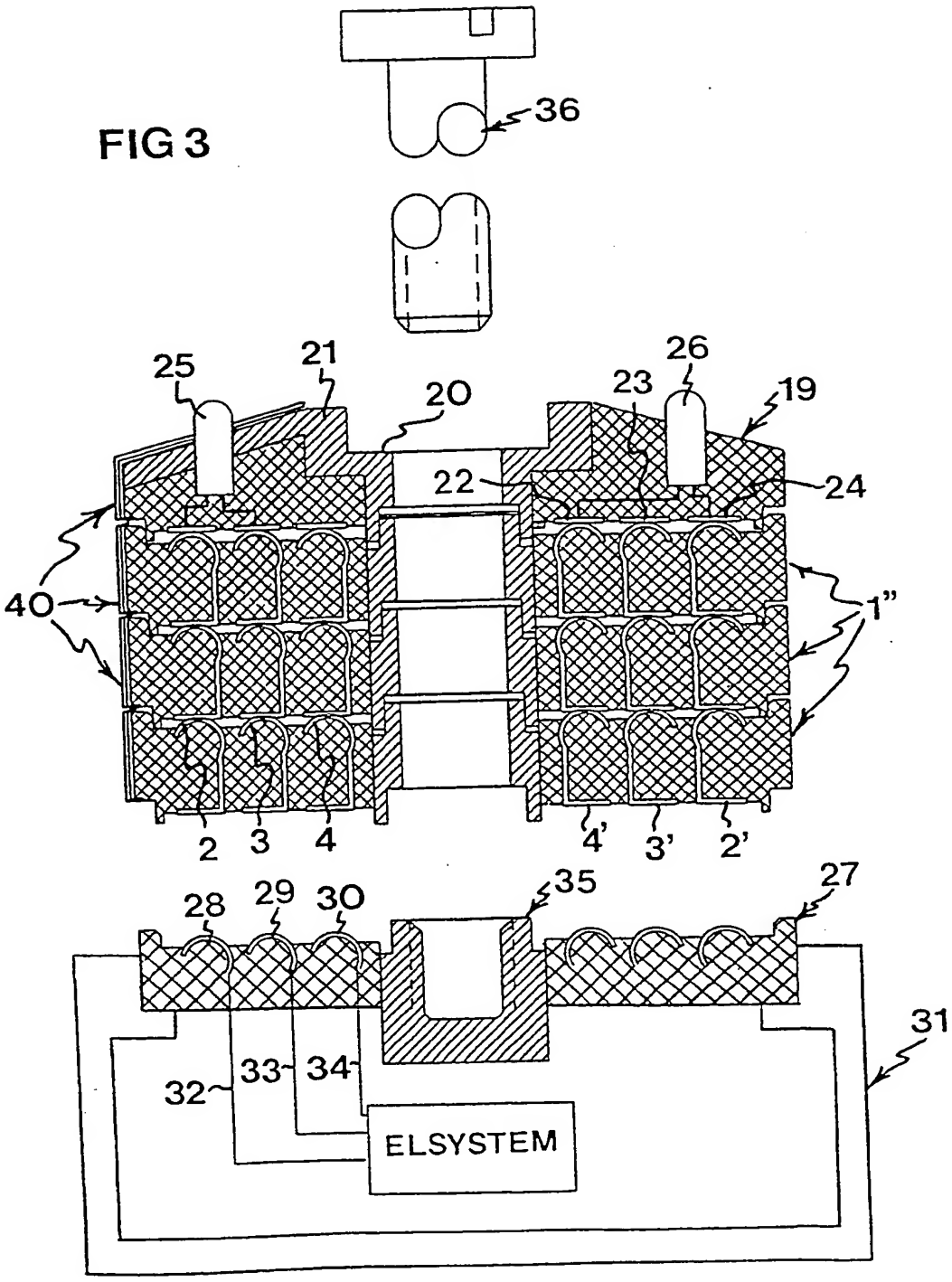

36
25
21
20
23
26
19
22
24
40
1"
2
3
4
4'
3'
2'
28
29
30
35
27
31
32
33
34
ELSYSTEM

FIG4

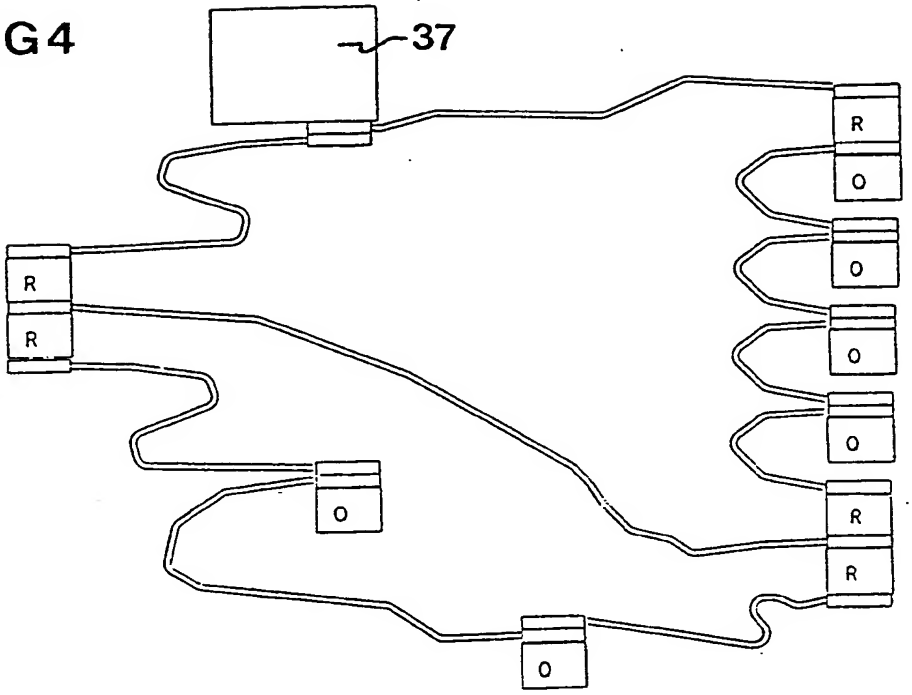


FIG5

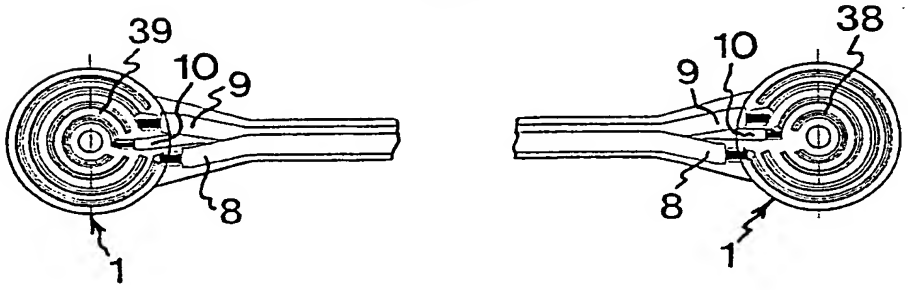


FIG6

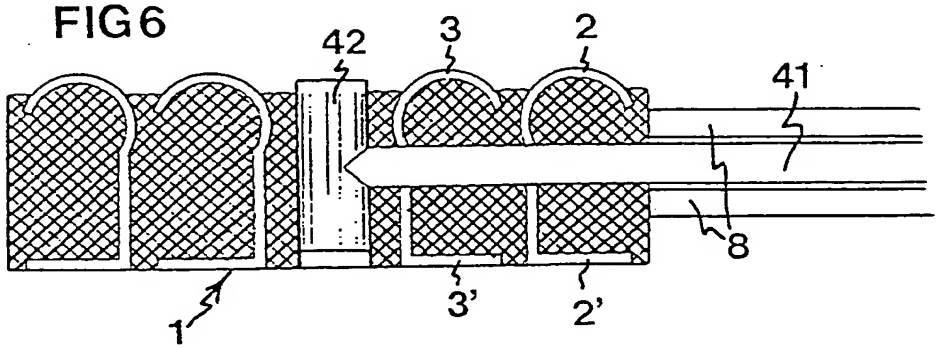
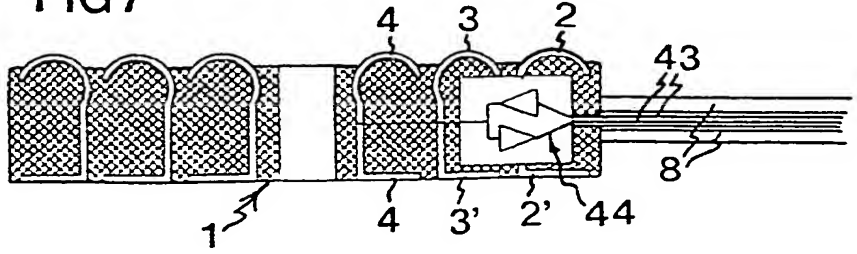


FIG7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE 96/00885

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: H01R 23/26, H01R 35/00
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC6: H01R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

WPI

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4026618 A (R.J. STRAKA), 31 May 1977 (31.05.77), column 1, line 60 - column 2, line 48 --	1-16
A	US 4643508 A (W. SCHALLER), 17 February 1987 (17.02.87), column 7, line 31 - column 8, line 23 -- --------	1-16

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" erlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance: the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance: the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
22 October 1996	23 -10- 1996
Name and mailing address of the ISA/ Swedish Patent Office Box 5055, S-102 42 STOCKHOLM Facsimile No. +46 8 666 02 86	Authorized officer Håkan Sand Telephone No. +46 8 782 25 00

INTERNATIONAL SEARCH REPORT

Information on patent family members

01/10/96

International application No.
PCT/SE 96/00885

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 4026618	31/05/77	NONE	
US-A- 4643508	17/02/87	CH-A,B- 660816	15/06/87
		DE-A- 3203520	04/08/83